

The Long-Baseline Neutrino Experiment Project

LBNE 35 ton prototype

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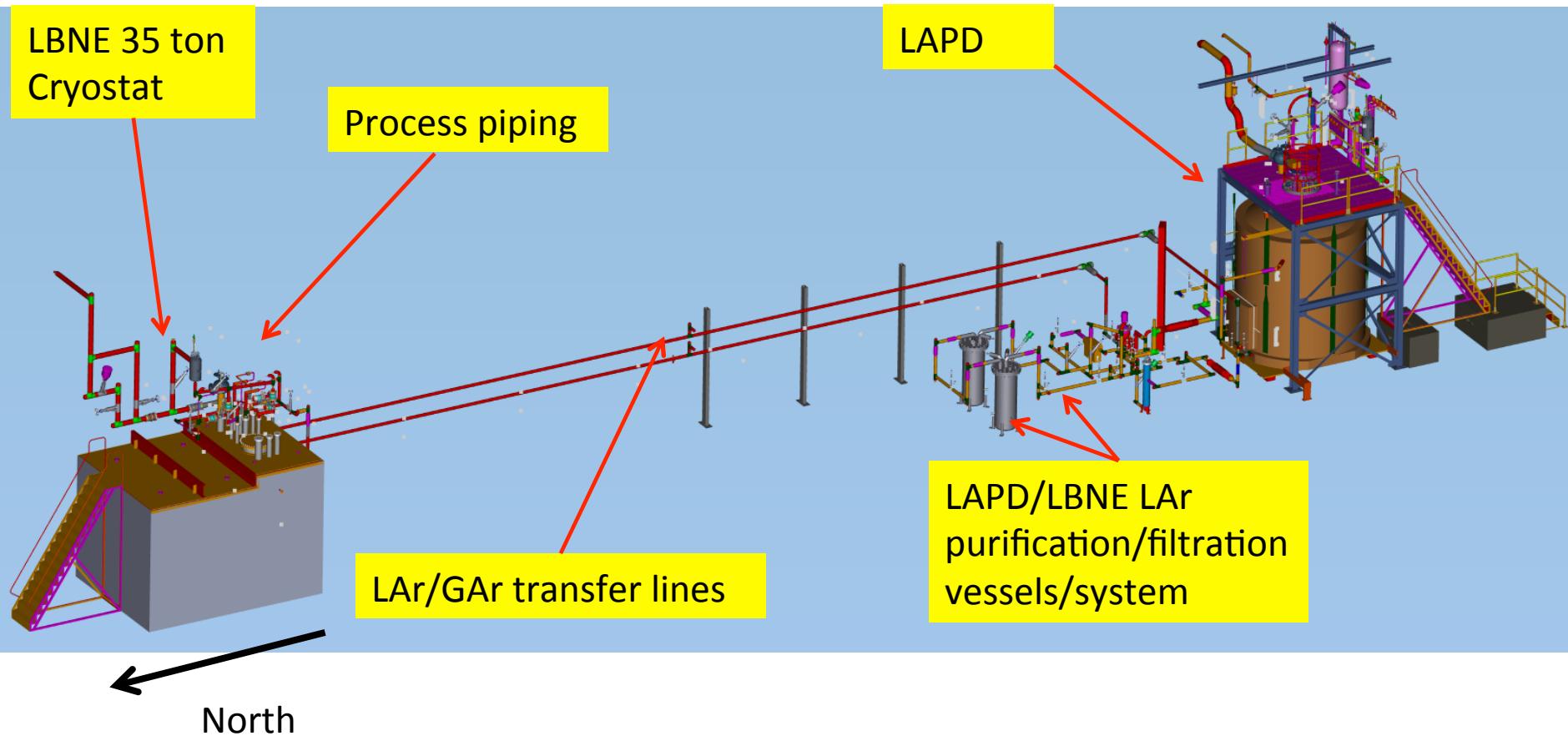
Outline

- Introduction
- Membrane Cryostat
- Cryogenic system
- Summary

Introduction

- LBNE wants to build a 10 kton Fiducial Mass Liquid Argon detector (two 5/9.3 kton FM/TM for a total of 19.8 kton).
- Membrane cryostat technology with passive insulation (Polyurethane foam).
- We have built the LBNE 35 ton prototype (the first and only membrane cryostat for scientific purpose and available to scientists) with the goals of:
 - demonstrating the membrane cryostat technology (thermal performance, feasibility for LAr, leak tightness).
 - demonstrating the contractual business model with membrane cryostat supplier for the design and construction of a membrane cryostat → DONE.
 - demonstrating that we can achieve the purity requirements in a membrane cryostat W/O evacuation.
 - achieving and maintaining purity requirements during filling, purification and maintenance mode.

Layout in PC-4

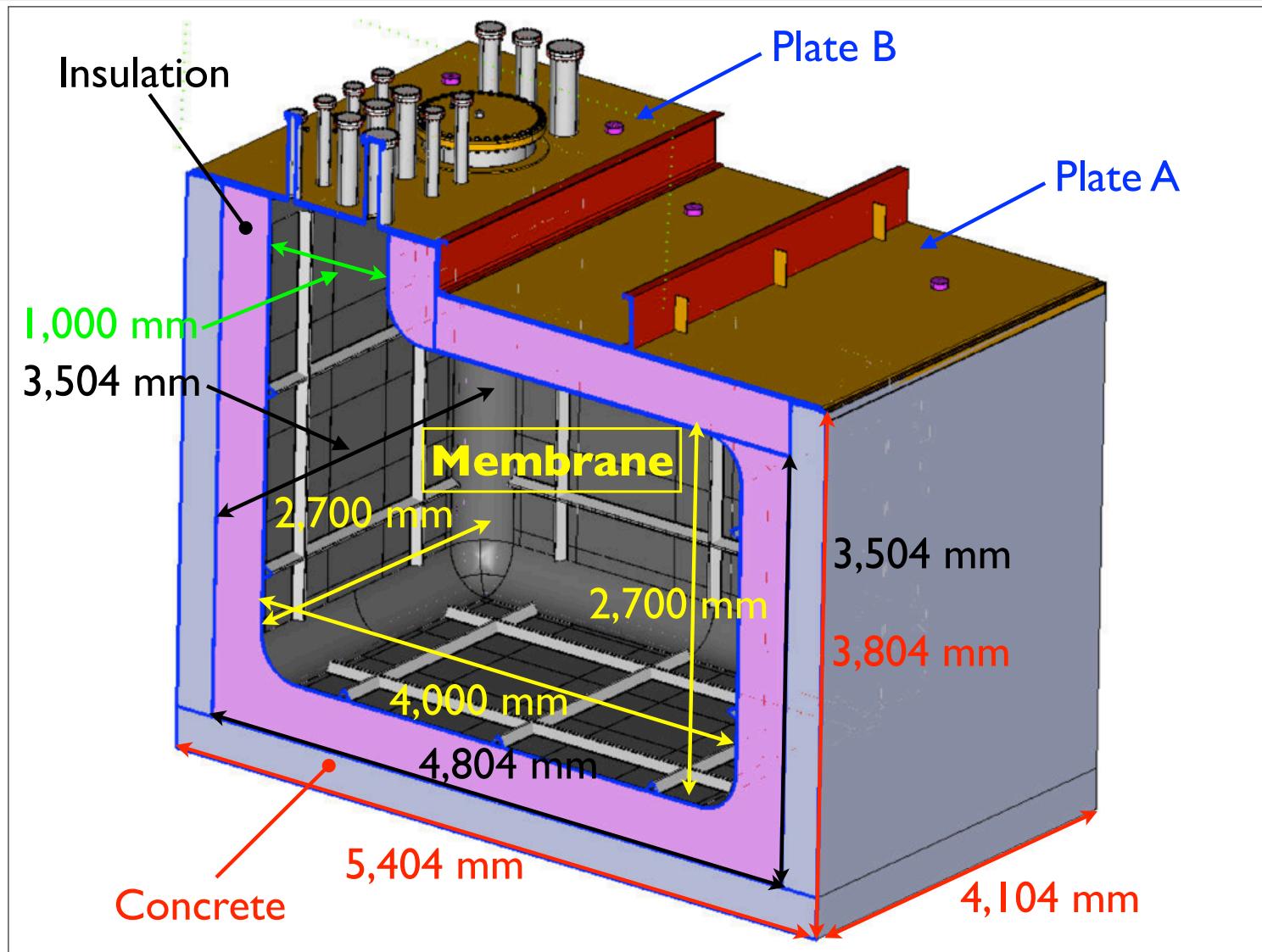


LBNE 35 ton Prototype

- First and only membrane cryostat built for scientific purpose (Commercial technology) and available to scientists.
 - Primary Membrane (2 mm SS 304): 2.7m x 2.7m x 4.0m inner dimensions.
 - Secondary/Sub-Secondary Membrane
 - 2 Layers of Polyurethane insulation (Total 400 mm → < 15 W/m² heat loss).
 - One instrumented top plate with all penetrations.
- IHI: design, procurement, supervision.
- Fermilab: built cryostat according to IHI procedures and training.
- Fermilab/LBNE gained experience with legal/technical aspects of the design and fabrication of membrane cryostats:
 - A lot of fit-up and adjustments on-the-field → need shop, tools and machinist(s) on-site.
 - A lot of field work.
- Cryogenic purification system: shared with LAPD → Mol sieve + Copper (achieved > 5 ms lifetime).
- Fermilab: design, procurement, fabrication of the cryogenic system.

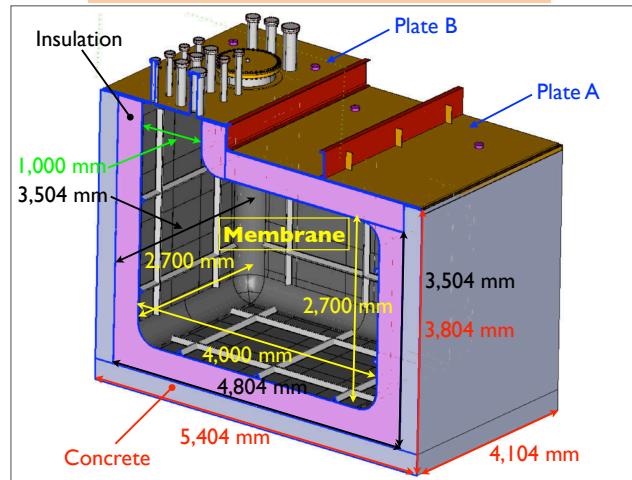
Membrane Cryostat

35 ton Prototype – Drawing



35 ton Prototype in Pictures

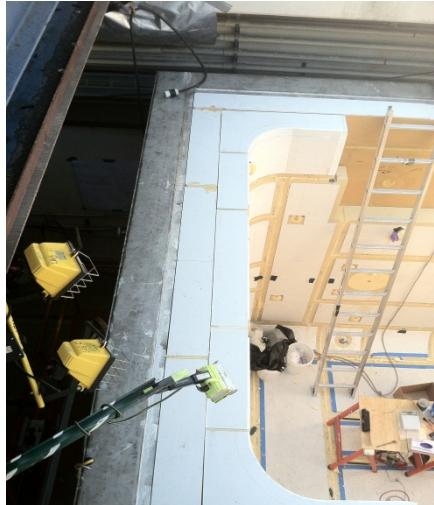
3 D Model of IHI Tank



Concrete Structure @ PC4



Carbon Steel Vapor Barrier

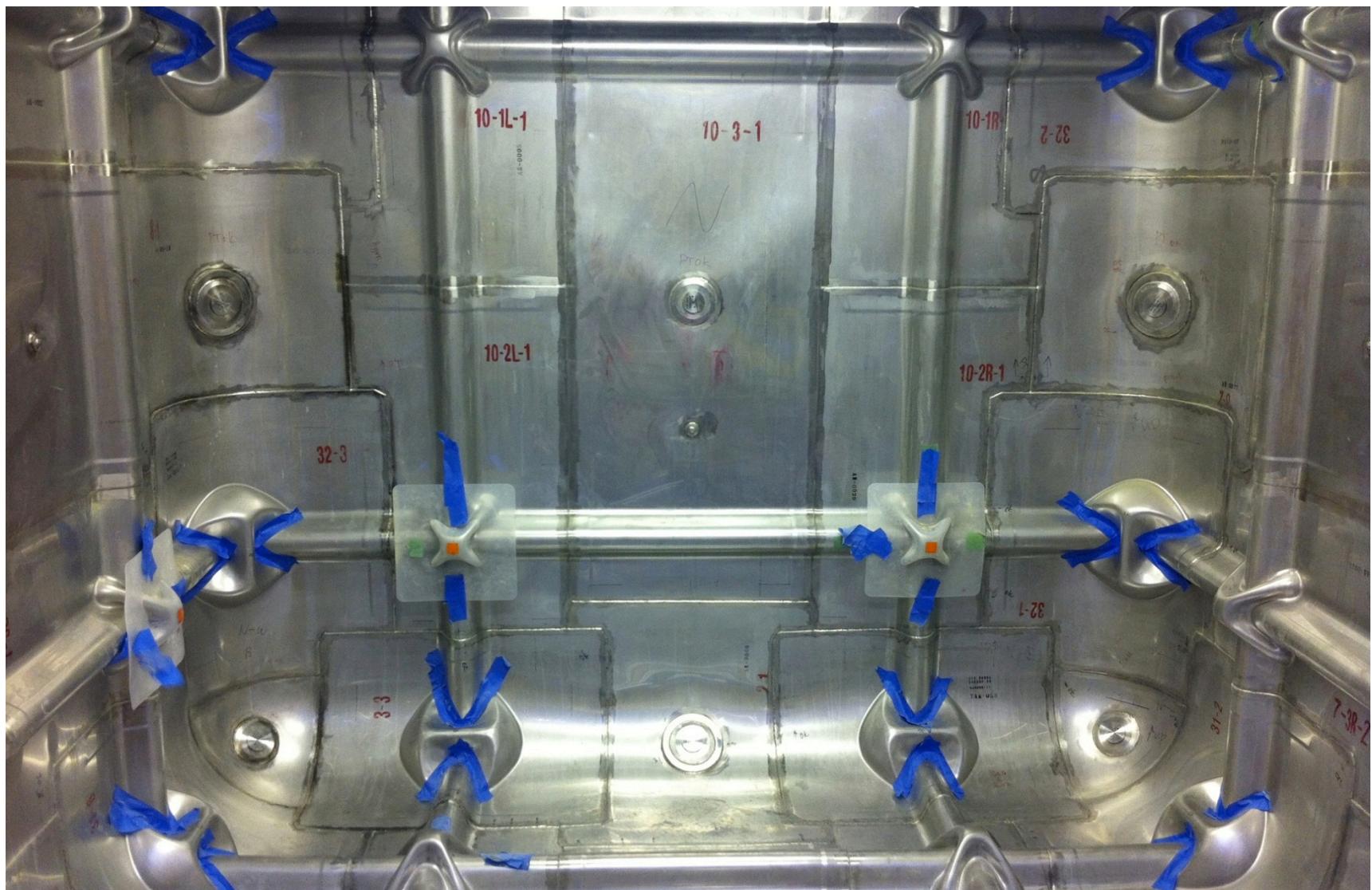


Two layers of foam (0.4 m)

Top View of Two Layers Foam

SS membrane Insert Begins

35 ton Prototype in Pictures – Inside View



Top view of the completed cryostat



Cryogenic System

Cryogenic System – 1



Piping runs from 35t to LAPD complete.



Piping connection at LAPD is complete.

Cryogenic System – 2



Top of the Tank with Ar Condenser



Top of the Tank



Close view of the top of the tank



Top view of the top of the tank



Fabrication of the LN₂ line

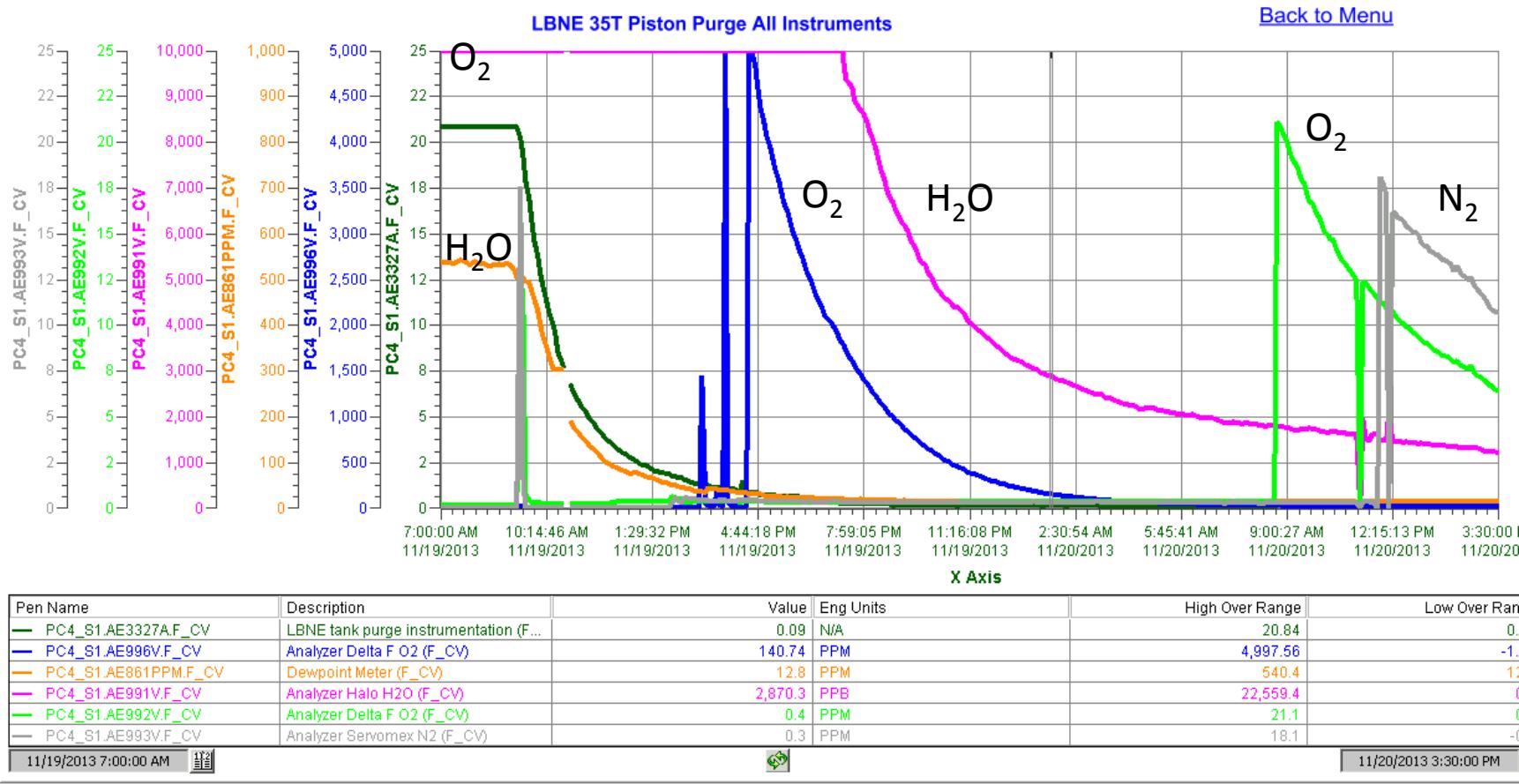


LAr filling lines

Commissioning

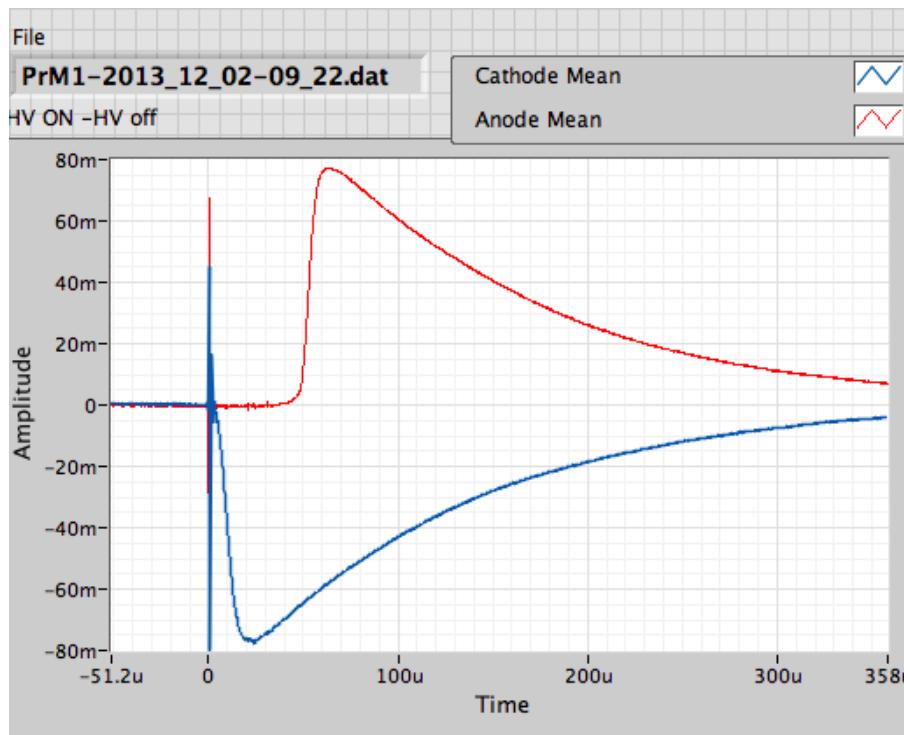
Piston Purge

- O₂ 21% to 6.6 ppm, N₂ 78% to 10.7 ppm, H₂O 540 ppm to 1.2 ppm.
- Total of 10.7 volume exchanges.
- Similar to LAPD results.



Electronics

- All Purity Monitors are working and being commissioned in GAr with Xe flashlight.
- Reading from one of the Purity Monitors.



Summary

- We have completed the installation of the Membrane Cryostat.
- We have completed the installation of the Cryogenic System and the connections to the existing LAPD purification system.
- We have obtained safety and ORC approvals.
- Commissioning is ongoing:
 - Piston purge completed.
 - Tank gas is re-circulated at room temperature thru the mole sieve and oxygen filters in a closed loop.
 - Debugging phase to ensure system integrity and functionality prior to cool down of cryostat.
- Cryostat will then be filled with LAPD liquid argon.
- After the purity tests (Phase 1) we plan to insert TPCs inside the cryostat and take data (Phase 2).

Thanks